PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

RECEIVED
08 SEP 2004
WIPO PCT

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P02039WO2A		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 03/27081	29.08.2003	30.08.2002
International Patent Classification (IPC) or both national classification and IPC		
C08C19/44		
Applicant		
BRIDGESTONE CORPORATION et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
30.03.2004	03.09.2004
Name and mailing address of the International preliminary examining authority:	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Knutzen-Mies, K Telephone No. +49 89 2399-8525

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US 03/27081

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-30 as originally filed

Claims, Numbers

1-9 as amended (together with any statement) under Art. 19 PCT

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☒ the claims, Nos.: 10
- ☐ the drawings, sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

see separate sheet

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-9
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-9
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-9
	No:	Claims	

2. Citations and explanations

see separate sheet

ad item I.:

There is no support in the application as originally filed for the last two process steps of new claim 3 of the present application contrary to the provisions of Article 19(2) PCT. This subject matter will be disregarded in the evaluation of novelty and inventive step in the following item V.

ad item V.:

None of the documents cited in the international search report discloses or fairly suggests a functional polymer having a sulfur containing heterocycle as terminating functional group as defined in claim 1 of the present application. A method for preparing a functional polymer by terminating a living polymer with a functionalizing agent containing a sulfur heterocycle and a method for curing a rubber formulation containing said functional polymer and a filler is also neither known from nor suggested by the prior art.

The subject matter of claims 1 - 9 of the present application (insofar as they comply with Article 19(2) PCT) is therefore considered to fulfil the requirements of Article 33(2) - (4) PCT.

additional remarks:

The description and worked examples remain to be adapted to the limitations of claim 1 (Article 6 PCT).

CLAIMS

What is claimed is:

1. A functional polymer that is defined by the formula

$$\pi\text{-}R^1\text{-}\alpha$$

where π is a polymer chain, R^1 is a bond or a divalent organic group, and α is a sulfur-containing heterocycle selected from a thiirane, thietane, thiolane, thiazoline, dihydrothiophene, thiadiazine, thioxanthene, thianthrene, phenoxathiin, dihydroisothiazole, or thienofuran group or substituted form thereof.

2. A method for preparing a functional polymer, the method comprising:

terminating a living polymer chain with a functionalizing agent where the functionalizing agent is defined by the formula

$$Z\text{-}R^4\text{-}\alpha$$

where Z is a leaving group or an addition group, R^4 is a bond or a divalent organic group, and α is a sulfur-containing heterocycle selected from a thiirane, thietane, thiolane, thiazoline, dihydrothiophene, thiadiazine, thioxanthene, thianthrene, phenoxathiin, dihydroisothiazole, or thienofuran group or substituted form thereof.

3. A method for preparing a cured tire component, the method comprising:

providing a rubber formulation comprising at least one vulcanizable rubber and a filler, where the at least one vulcanizable rubber is a functional polymer that is defined by the formula

$$\pi\text{-}R^1\text{-}\alpha$$

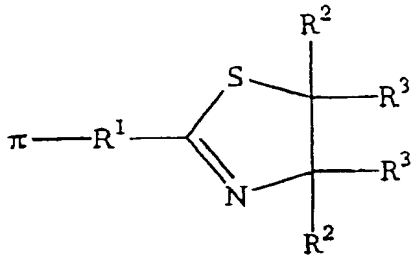
where π is a polymer chain, R^1 is a bond or a divalent organic group, and α is a sulfur-containing heterocycle selected from a thiirane, thietane, thiolane, thiazoline, dihydrothiophene, thiadiazine, thioxanthene, thianthrene,

phenoxathiin, dihydroisothiazole, or thienofuran group or a substituted form thereof;

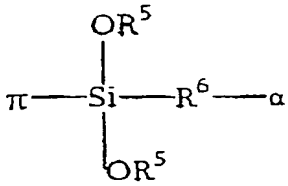
forming the rubber formulation into a green tire component;

vulcanizing the green tire component to form a cured tire component.

4. The polymer of claim 1, or the method of claim 3, where the functional polymer can be defined by the formula



where π is a polymer chain, R^1 is a bond or a divalent organic group, each R^2 is independently hydrogen or a monovalent organic group, each R^3 is independently hydrogen or a monovalent organic group, or where each R^3 combine with each other to form a divalent organic group; or where the functional polymer can be defined by the formula



where π is a polymer chain, each R^5 is independently a monovalent organic group, R^6 is a bond or a divalent organic group, and α is a sulfur-containing hererocycle.

5. The polymer of claim 1, or the method of claim 3, where R^1 includes the residue of an addition reaction between an addition group and a living polymer, and wherein the addition group comprises a nitrile group, a Schiff base, a ketone group, an aldehyde group, or an ester group.

6. The polymer of claim 1, or the method of claim 2 or 3, where the polymer chain is a rubbery polymer having a Tg that is less than 0°C.

7. The polymer of claim 1, or the method of claim 2 or 3, where the polymer chain is polybutadiene, polyisoprene, poly(styrene-*co*-butadiene), poly(styrene-*co*-butadiene-*co*-isoprene), poly(isoprene-*co*-styrene), or poly(butadiene-*co*-isoprene).

8. The method of claim 2, where Z comprises a halide, a thio alkoxide group, an alkoxide group, a dialkyl amine group, a nitrile group, a Schiff base, a ketone group, an aldehyde group, or an ester group.

9. The method of claim 3, where the filler is carbon black, silica or both.